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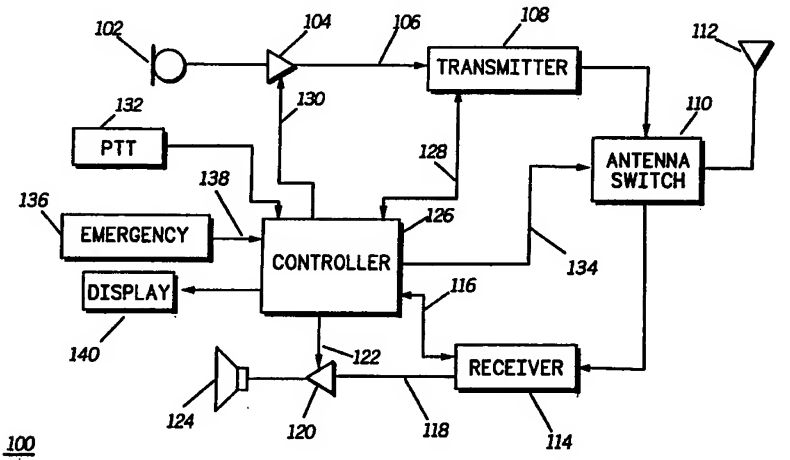
(54) Title: RADIO CAPABLE OF AUTOMATIC SYSTEM SELECTION IN EMERGENCY SITUATIONS



(57) Abstract

A radio (100) attempts to transmit an emergency information signal in a first communication system (302) and then attempts to send the emergency information signal automatically in a second communication system (304) after determining that the emergency information signal was not successfully transmitted in the first system (302). Radio controller (126) can alter the configuration of radio (100) in order for the radio to transmit the emergency information signal to a number of different types of communication systems having different operating modes.

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RADIO CAPABLE OF AUTOMATIC SYSTEM SELECTION IN EMERGENCY SITUATIONS

Technical Field

This invention relates generally to communication systems, and more specifically to a method and apparatus for providing improved emergency communications.

Background

Radios which are capable of transmitting emergency information signals are well known in the radio communications art. Such radios normally transmit an emergency information signal whenever a certain condition, such as the activation of an emergency switch, occurs at the radio. Present day radios will normally transmit the emergency signal one or more times or until an acknowledgment signal, indicating the reception by the system of the emergency signal, has been received at the radio. Unfortunately, present day radios do not address or solve the problem of the radio not being able to successfully communicate with the system. In this particular situation, present day radios fail to achieve successful emergency communications. In emergency situations where the radio is being used by a policeman or fireman, the need for the emergency signal to be received is sometimes critical. A need exits for a radio which, upon determining that an emergency communications has been unsuccessful in one system, will automatically attempt to access other communication systems.

Summary of the Invention

A radio communication device, having emergency communications capabilities, includes a microprocessor for generating an emergency information signal in a first operating mode, and a transmitter for transmitting the emergency information signal. The radio then determines if the emergency information signal was successfully transmitted by determining if an acknowledgement signal or other appropriate signal has been received by the radio's receiver. If no acknowledgement is received within a predetermined period of time, the radio's microprocessor switches the operating mode of the radio to a second operating mode and the radio attempts one more time to successfully transmit an emergency information signal. In one aspect of the invention, the radio transmits the emergency information signal a predetermined number of times in the first operating mode prior to switching to the second operating mode.

Brief Description of the Drawings

FIG.1 shows a block diagram of a radio communication device in accordance with the present invention.

FIG. 2 is a flow diagram illustrating how a normal emergency transmission sequence occurs in accordance with the present invention is shown.

FIG. 3 is a block diagram of a radio communication device operating in range of two systems in accordance with the present invention.

Detailed Description of the Preferred Embodiment

Referring now by characters of reference to the drawings and first to FIG. 1, a block diagram of a conventional radio 100 such as a portable radio capable of operating in both trunked and conventional radio communication systems, is shown. Radio 100 includes a receiver 114 which is used for receiving information signals from other radios and systems and a transmitter means comprising a transmitter 108 for transmitting information signals. Radio 100 also includes an antenna switch 110 which selectively

couples antenna 112 to either receiver 114 or transmitter 108. Antenna switch 110 is controlled by controller 126 via line 134, in order to effectuate the coupling of antenna 112 to either transmitter 108 or receiver 114. Both receiver 114 and transmitter 108 are of conventional design as known in the art. When receiving a message, an incoming radio frequency signal is routed from antenna 112 to receiver 114 where the signal is decoded. If the signal is determined to be a voice message, the message is routed via line 118 to audio amplifier 120 which amplifies the voice message for presentation to speaker 124. The radio's controller means which is controller 126 can control the volume of the output audio signal by adjusting the gain of amplifier 120 via line 122. The gain of amplifier 120 is normally indirectly controlled by the turn of a volume control knob (not shown) found in radio 100, by the radio user.

Controller 126 is in charge of coordinating all activities of radio 100 including control of both transmitter 108 and receiver 114. Controller 126 preferably comprises a conventional microprocessor or microcontroller, having on-chip memory, I/O lines, and the capability for external memory device interfacing. In the present invention, radio 100 is preferably a dual mode radio which can operate in both a conventional and trunked radio communication system. When operating in a trunked system, controller 126 controls the automatic switching of frequencies for both the transmitter 108 and receiver 114 depending on instructions which are received from the trunked system central controller. Control information signals such as emergency acknowledgement messages which are received are routed from receiver 114 via bus 116 to controller 126 for further processing. When operating in a trunked system, controller 126 will generate all of the signalling packets required by radio 100, such as those required when an emergency communications is initiated by the radio user. Controller 126 will also be in charge of setting up all of the operating parameters for radio 100 whenever the radio is switched to a new operating mode (i.e changing radio 100 from conventional to trunked system operation) including the

generation of emergency information signals which are appropriate to the radio's operating mode.

In a conventional radio communication system, controller 126 will be called on to decode digital signals which are received by receiver 114, such as MDC-1200 ™ signaling messages. MDC-1200™ is a 1200 baud digital signalling protocol developed by Motorola, Inc; primarily for radio communication data signalling. Controller 126 will encode these digital signals when radio 100 needs to transmit such things as an emergency communications transmission (emergency information signal) in a conventional system, and will also decode digital signals which are received in the form of acknowledgement messages from the system base stations.

In order for radio 100 to transmit a voice message, the PTT switch 132 is activated by the radio user which in turn activates transmitter 108 via a signal generated by controller 126 via bus 128. During a normal voice transmission, the radio user speaks into microphone 102 which converts the audio signal into electrical signals which are in turn amplified by amplifier 104. Amplifier 104 has gain adjustment capability via line 130 which is controlled by controller 126. The amplified signal is then feed to transmitter 108 via line 106 which converts the signal to a radio frequency signal and transmits the R.F. signal through antenna switch 110 for presentation to antenna 112. Any control messages, such as emergency information signals which are generated by the activation of emergency switch 136 (which is sent via line 138 to controller 126) for example, are generated by controller 126 and sent via bus 128 to transmitter 108 for transmission. Controller 126 is also in charge of configuring radio 100 as to what functions and features can be used, depending on the type of system (operating mode) the radio is presently on. For example, if the emergency switch 136 had been pressed by the radio user when the radio was in a trunked radio system, the emergency message generated would be different then the emergency message generated by controller 126 had the radio been operating in a conventional radio system. This is primarily

due to the fact that the signalling protocols are quite different between a trunked radio system and a conventional radio system. For example, radio 100 might use an MDC-1200™ signalling protocol in a conventional system operating mode, but use a different trunked system signalling protocol when operating in the trunked mode.

In FIG. 2 a flow diagram illustrating how a normal emergency transmission sequence occurs, in accordance with the present invention is shown. After an emergency situation is initiated, normally by activating emergency switch 136, a signal to controller 126 is sent via line 138 in order for controller 126 to generate an emergency information signal. In step 200, the emergency transmission is sent by transmitter 108 after the emergency information signal is sent via bus 128 to transmitter 108. Controller 126 keys up transmitter 108 via bus 128 in order for the emergency transmission to be sent. For purposes of the following discussion we will assume that the first mode of operation for radio 100 is a conventional radio system mode. In step 202, radio 100 waits for an acknowledgement back from the system base station informing radio 100 that the base station received the emergency transmission. In this specific case, an MDC-1200™ emergency acknowledgement message coming from the system base station is the acknowledgement that radio 100 is waiting for. Radio 100 will have a detection means comprising of receiver 114 for receiving the acknowledgement signal and controller 126 for decoding the acknowledgement signal in order to determine if the emergency information signal has been successfully transmitted. In step 204, if the acknowledgment signal is received by radio 100, controller 126 in turn informs the radio user that the emergency signal was acknowledged. This can be done in a number of ways, for example, by generating tones which are outputted via speaker 124 and/or displaying a message on display 140.

After the radio user has been informed of the successful emergency transmission, the routine is exited in step 214. In step 202, if the acknowledgment signal is not received within a

predetermined time frame which is stored in controller 126, the routine moves to step 206 where it is determined if the emergency retry sequence is exhausted. For example, a retry counter could be set for fifteen tries and stored in controller 126. In other words radio 100 will attempt transmission of the emergency information signal fifteen tries with appropriate waits for acknowledgments between each successive transmission attempt. If in step 206 it is determined that the retry counter has not reached zero, the counter is decrement and the routine goes back to step 200 which retransmits the emergency message, this loop is continued until the retry counter has reached zero. Once it is determined in step 206 that the retry sequence has been exhausted without a successful acknowledgment back from the system, the routine moves to step 208. In step 208, if an alternate emergency mode operation has been enabled (i.e. the present invention), the radio controller 126 will switch radio 100 to a second operating mode such as another conventional system or a new trunked communication system. In the foregoing discussion we will assume that in step 208 radio 100 is switched to a new trunked communication system. This switch to a new operating mode is accomplished by controller 126 which switches all of the radio operating characteristics such as transmitter 108 and receiver 114 operating frequencies, communication protocols, and other radio operating characteristics and features.

If in step 208 a second emergency operating mode was not enabled, controller 126 informs the radio user of the failed emergency communications transmission in step 212, and the routine is exited in step 214. But if in step 208 the alternate emergency mode had been previously enabled, radio 100 will automatically switch to the second mode of operation. In step 210, radio 100 reconfigures itself in order to operate in the new trunked operating mode prior to retransmitting the emergency message in the new mode. Also in step 210, radio 100 would start looking from a list of possible trunked control channels that it is allowed to operate in to see if it capable of locating an active control channel which would indicate radio 100 was "in range" of

a trunked communication system. If an active control channel is located, the routine would begin transmitting an emergency information signal in step 200 and the sequence previously discussed would be duplicated. The number of new operating modes which radio 100 could attempt an automatic emergency transmission without any further user intervention could be endless. Practically, the number of systems would be limited to the number of systems which radio 100 could access (i.e. in range).

In FIG. 3 radio 100 is shown in range of two different systems, a first system 302 and a second system 304. Each of the two systems can be any one of a number of different communications systems such as trunked radio communication systems, conventional radio communication systems, cellular systems, and other related communication systems. Assuming that radio 100 is presently operating in the first system 302, and radio 100 initiates an emergency communication transmission, it will send the emergency information signal to base station 306 where it will be received and an acknowledgment signal will be sent back to radio 100. With the present invention, if radio 100 after a predetermined number of attempts at trying to get an acknowledgment back from base 306 is unsuccessful, radio 100 will automatically switch modes of operation without user intervention, and begin transmitting to control channel 308 in the second system 304 which in this case is a trunked radio system. The second system 304 could be a different type of communication system altogether than the first system 302, such as a trunked radio communication system as in this particular example. In this particular case, radio 100 would be communicating over the system control channel 308 to the system central controller 312. If the central controller 312 successfully receives the emergency information signal, it will transmit an acknowledgment signal back to radio 100 via control channel 308. If the emergency information signal is not successfully received by central controller 312 after a number of attempts by radio 100 at trying to reach controller 312, radio 100 could abort

trying to send the emergency signal or attempt to communicate with a new system. Radio controller 126 could be programmed with all types of combinations as to the number of systems to attempt, the number of emergency transmissions to attempt per system, etc.

In summary, the present invention allows a radio user the capability of automatically in an emergency situation to achieve successful communications by attempting to reach different communication systems 302 and 304. All prior art systems fail to automatically place a radio 100 into different operating modes (i.e. different types of systems) in order to retransmit a life threatening emergency transmission without any further user intervention, when all attempts at reaching one particular system have failed. Radio 100 can attempt to transmit to any number of radio communication systems that radio 100 may be in range of. This is a particular good feature in metropolitan areas where there are overlapping systems in which a radio user can attempt communications with different systems. Although the present invention has been shown specifically in operation between a conventional and trunked radio communication systems, the types of different communication systems which radio 100 can also operate in can include cellular systems, and other types of radio communication systems.

What is claimed is:

Claims

1. A radio communication device having emergency communications capabilities, comprising:

means for generating an emergency information signal in a first operating mode;

transmitter means for transmitting the emergency information signal in the first operating mode;

detection means for determining if the emergency information signal was unsuccessfully transmitted in the first operating mode; and

controller means responsive to the detection means for automatically initiating an emergency communication attempt in a second operating mode when the emergency information signal is determined to have been unsuccessfully transmitted in the first operating mode.

2. The radio communications device of claim 1, wherein one of the first and second operating modes is compatible with a conventional radio communications system, and the other of the first and second operating modes is compatible with a trunked radio communication system.

3. The radio communications device of claim 1, wherein the first operating mode is compatible with a first trunked radio communication system and the second operating mode is compatible with a second trunked radio communication system.

4. The radio communications device of claim 1, wherein the first operating mode is compatible with a first conventional radio communications system and the second operating mode is compatible with a second conventional radio communications system.

5. A radio communication device having emergency communications capabilities, comprising:

means for generating an emergency information signal compatible with a first communication system;

transmitter means for transmitting the emergency information signal in the first communication system;

detection means for determining if the emergency information signal was unsuccessfully transmitted in the first communication system; and

controller means responsive to the detection means for automatically initiating an emergency communication attempt in a second communication system when the emergency information signal is determined to have been unsuccessfully transmitted in the first communication system after attempting to transmit the emergency information signal a predetermined number of times in the first communication system.

6. The radio communications device of claim 5, wherein the emergency communication attempt in the second operating mode is not attempted until the radio communications device first determines that the radio communications device is in range of the second communication system.

7. A method of providing improved radio emergency communications, comprising the steps of:

(a) attempting an emergency communications in a first operating mode;

(b) determining if the emergency communications in the first operating mode was unsuccessful; and

(c) automatically attempting an emergency communications in a second operating mode if the emergency communications in the first operating mode was not successful.

8. The method of claim 7, wherein one of the first and second operating modes is compatible with a conventional radio communications system, and the other of the first and second operating modes is compatible with a trunked radio communication system.

9. The method of claim 7, wherein the first operating mode is compatible with a first trunked radio communication system and the second operating mode is compatible with a second trunked radio communication system.

10. The method of claim 7, wherein the first operating mode is compatible with a first conventional radio communications system and the second operating mode is compatible with a second conventional radio communications system.

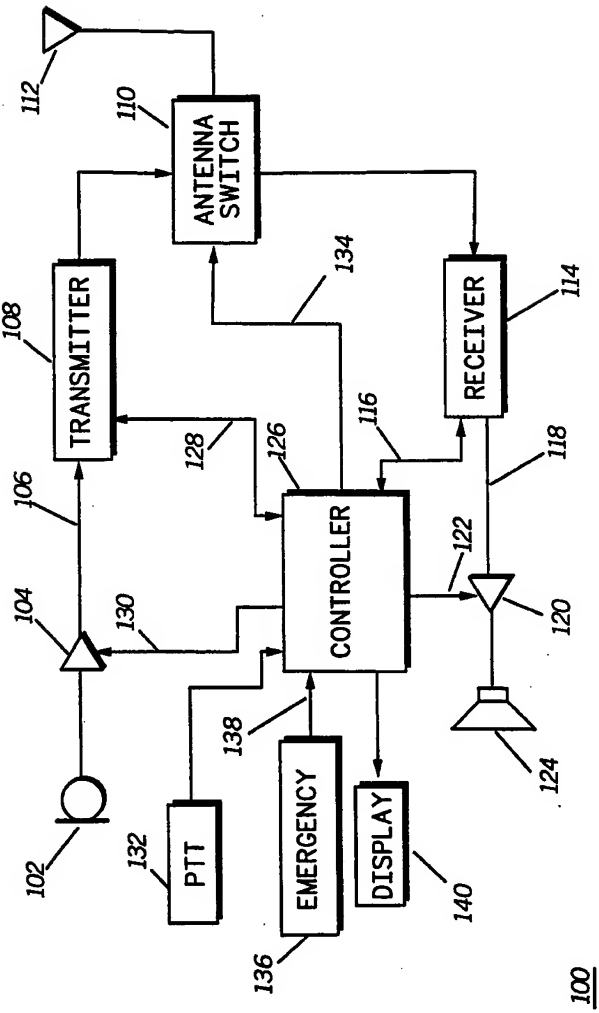
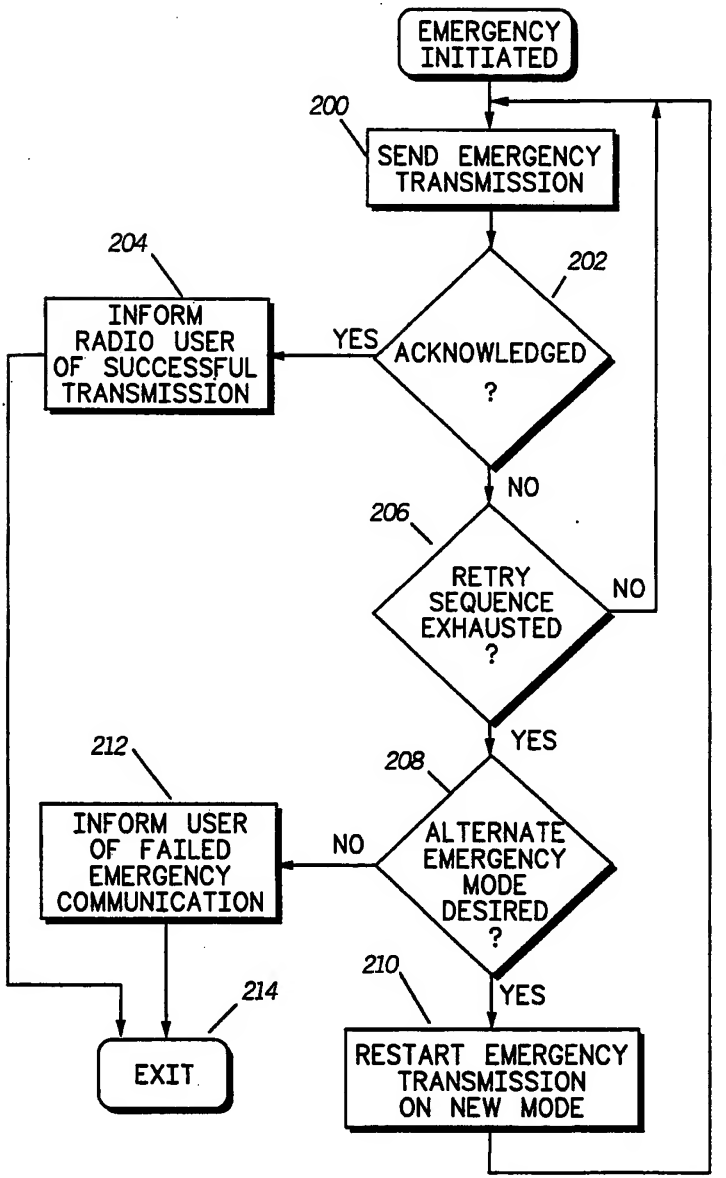

112
110
ANTENNA SWITCH
134
114
RECEIVER
108
TRANSMITTER
116
118
128
126
106
CONTROLLER
122
104
130
120
138
124
102
132
PTT
EMERGENCY
DISPLAY
140
136
100

FIG.1

FIG.2


EMERGENCY INITIATED
200
SEND EMERGENCY TRANSMISSION
202
ACKNOWLEDGED ?
YES
204
INFORM RADIO USER OF SUCCESSFUL TRANSMISSION
NO
206
RETRY SEQUENCE EXHAUSTED ?
NO
YES
208
ALTERNATE EMERGENCY MODE DESIRED ?
NO
212
INFORM USER OF FAILED EMERGENCY COMMUNICATION
YES
210
RESTART EMERGENCY TRANSMISSION ON NEW MODE
214
EXIT

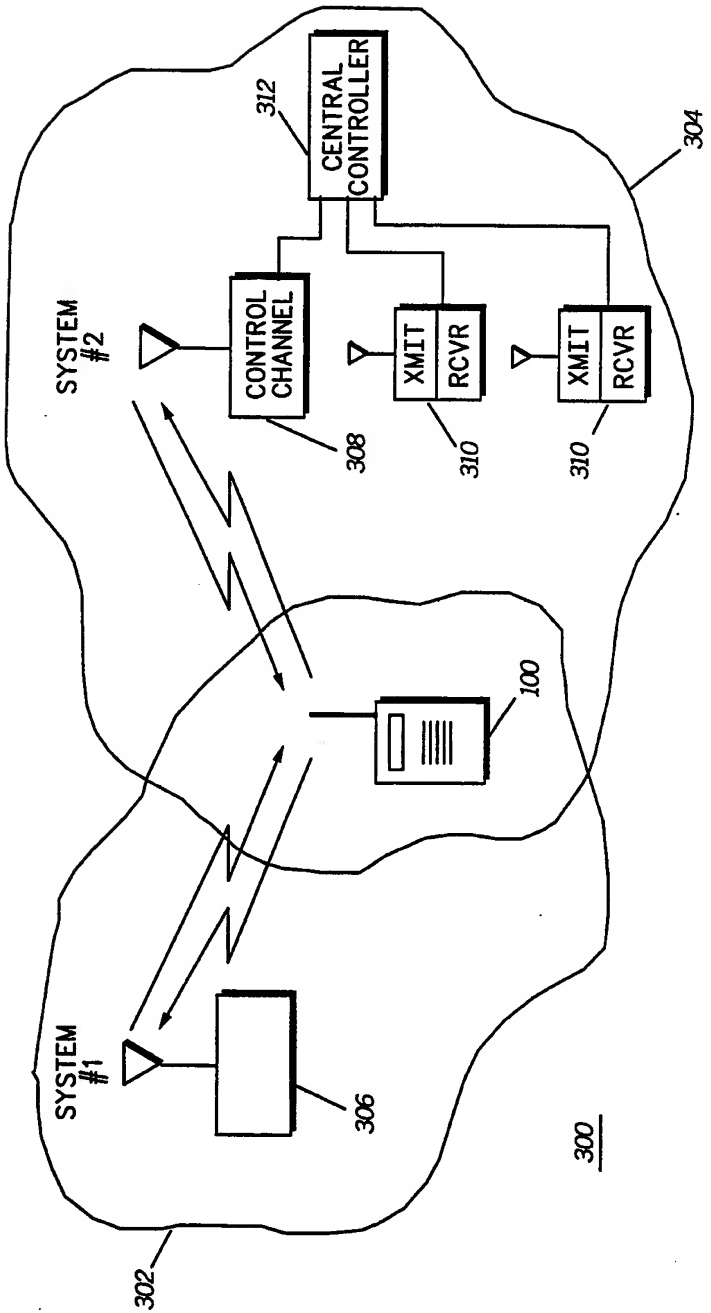

CENTRAL CONTROLLER
312
304
SYSTEM #2
CONTROL CHANNEL
308
XMIT
RCVR
310
XMIT
RCVR
310
100
SYSTEM #1
306
300
302

FIG.3

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US92/00911

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5) H04Q 7/02 H04Q 9/02 H04B 1/44 H04B 7/00

US: 455/33, 34, 35, 38, 53, 54, 56, 78

II. FIELDS SEARCHED

Minimum Documentation Searched ⁷

Classification System	Classification Symbols
US	455: 33, 34, 35, 38, 53, 54, 56, 58, 78, 89 379: 40, 46, 51, 58, 61

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸

III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹

Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US, A, 4,594,491 (Burke) 10 June 1986 See column 16, lines 25-65	1-10
Y	Motorola, Inc., SPECTRA Conventional Radio System Manual, 1989 39 pages, See pages 19-20	1-10
Y	Motorola, Inc., Systems Saber Catalog Sheet R3-4-136A, 1990 pages 1-8, see pages 2 and 4	2-10

* Special categories of cited documents: ¹⁰

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 April 1992	

International Searching Authority	Signature of Authorized Officer
ISA/US	Lisa Charouel

Form PCT/ISA/210 (second sheet) (Rev.11-87)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter [2] not required to be searched by this Authority, namely:

2. ☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [3], specifically:

3. ☐ Claim numbers_____, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.